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Software Architecture Technology User Network (SATURN)

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Working Session Notes

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Proposed Topics

The following topics were proposed during a brainstorming and consolidation session.

1. How to build a software architecture community
   - Organizational conditioning to accept architectural practices
2. Gaps in the methods
   - Tailoring methods
   - Standardizing ATAM, value? How to go about it?
   - Applicability (e.g., enterprise architectures)
   - What is prerequisite knowledge (Domain knowledge) for ATAM
3. What to measure
4. Relationship of architecture and process – how to build systems (organization as a whole to meet QA requirements)
5. What are people doing with quality attribute scenarios
6. Architecture reconstruction
7. Architecture visualization

Working Session Topics

These three topics were selected for the working sessions:

- Gaps in the methods
- Measurement
- Architecture and process

Gaps in the Methods

The charge to this working session was to discuss the following topics:

- Tailoring ATAM
- Prerequisite knowledge to performing an ATAM
- Standardizing ATAM
- Applicability of ATAM to large systems, to enterprise architectures, to system architectures

Gaps in the Methods – Tailoring ATAM

The attendees were happy with the steps of ATAM but made some suggestions for improving the process of capturing the results. These were:

- Include measures of the system (size, number of distinct locations where it was being developed, number of developers) in the statistics kept
- Include follow up that questions response of developers to risks. AT&T uses a phone conference 3-4 weeks after the conclusion of a review for the developers to report their actions on the serious risks.

There was also a comment that nothing should be done to change the ATAM from a collaborative exercise between the evaluators and the project into an adversarial exercise.

Gaps in the Methods - Prerequisite knowledge to performing an ATAM -1

There was general agreement that the evaluation team should include expertise in:

- ATAM
- Quality attributes of importance to the system being reviewed
- Domain knowledge

There was also general agreement that not every member of the team needed to know all of these areas. Different teams would be constituted from among the available personnel so that all of the prerequisite knowledge is represented.

Gaps in the Methods - Prerequisite knowledge to performing an ATAM -2

Gaining the prerequisite knowledge about ATAM can be done in a variety of fashions:

- Taking the SEI courses
- Buying the ATAM evaluation book
- Participating in ATAMs led by trained evaluators.

The method of entry becomes a cost/benefit question. Taking the courses and receiving training reduces the learning time and the probability of errors. There is a cost for the courses however. Different members of the group who had performed ATAMs had arrived there via different routes.

Gaps in the Methods – Standardizing ATAM

The group felt that if ATAM had some sort of official recognition, it would become easier for them to convince their organizations to perform ATAMs. One possible method to achieve official recognition was for ATAM to become an official (IEEE or ISO) standard.

Another method was for the DoD to require ATAMs for their large contracts. The Army is currently putting language in their REFs for ACAT I and II programs that requires ATAMs to be performed.

Although the group felt that having an official standard would be beneficial, none of the group was willing to participate in standardization efforts.

Gaps in the Methods – Applicability of ATAM to Large Systems -1

The applicability of ATAM to large systems, enterprise and system architectures introduces problems of scale and scope.

The problems of scale come about regardless of whether ATAM is applied to a software architecture, a system architecture, or an enterprise architecture. The scale problem comes about because in a large system with multiple subsystems, evaluating both the interactions among the subsystems and the subsystems themselves in a single ATAM causes problems because the issues are different for the evaluators, the stakeholders are different, and the important quality attributes may be different. One participant in the breakout group said "the larger the system, the more the evaluation focuses on management rather than on the technical issues".

Gaps in the Methods – Applicability of ATAM to Large Systems -2

The problems of scope come about, especially, in a system architectural context. Although ATAM is agnostic with respect to the quality attributes it is used to evaluate, when examining system architectures, attributes such as power consumption, physical footprint, and physical environment are important. The types of expertise needed in the evaluation team becomes very large.

The group recommends that scoping problems be dealt with in Phase 0 and one indication of the scope of an evaluation is the operational concept. If the system to be evaluated has an operational concept defined then the evaluation can concentrate on the scope of that concept and not delve too deeply into the subsystems included in the scope or too high into the context within which the scope exists.

The group also raised the possibility of a series of ATAMs for very large systems. One to examine the interactions among the subsystems together with others to examine the subsystems themselves.

Measurement

The What to Measure working session was chartered to discuss the subject of measuring cost and benefit of architecture and architecture-centric practices. Because there is a large body of work on measuring cost, we concentrated on benefit.

First, we established the groundwork for the discussion, covering what can be measured, why we measure, who does it and who consumes it, when to measure, and how to measure.

Measurement – What Can be Measured

We can measure products and artifacts, or we can measure the architecture process. Architecture-centric measures related to products and artifacts start with the quality attributes of the deployed system, quality attributes that the architecture is intended to imbue, such as its performance or security or availability. Some quality attributes are direct manifestations of business goals, such as time to market, return on investment, total cost of ownership, amount of reuse, success of product migration/evolution. Process-related measures include time and productivity measures, such as amount of rework or the cost of particular activities such as evaluation.

Measurement – Why We Measure

We measure to track progress, to see if we are meeting goals, and to be able to predict the future based on trends. In an atmosphere of architecture "evangelism," we also measure to make a case for architecture-centric development and practices. We measure to find a "poster child" activity that will make a positive case for architecture-based development, to establish a baseline for best practice and collect lessons learned.

Measurement – For Whom We Measure

Consumers of measures include leadership and management, financing authorities, sales and marketing staff, and the engineering departments.

Measurement – When Do We Measure

Here, the question is how early can we measure. Discussion here was abbreviated and reached no conclusions.

Measurement – How to Measure

Here, the discussion quickly arrived at the conclusion that how (and what and when) we measure should be tailored for producing the results useful to the stakeholders who need them. Also, because measurement can be a costly activity, only those measures necessary should be collected.

Measurement – Benefits of Architecture

What are the benefits of software architecture that we should expect to reveal through measurement? We brainstormed a short list of benefits, with each preceded by the stakeholder who would expect to see it:

- Marketing: Interoperability
- Management: Productivity
- CTO: Number of angry voicemails from CEO
- Product manager: Number of calls at service center
- Various: New mission capability in short time
- CEO, Marketing:: Revenue; allows price target to be met
- Marketing, CTO:: Product/feature diversity
- CEO: : Enabling strategic direction (e.g. globalize)
- COO, management: Increasing organizational knowledge
- Product manager: Stable with respect to new technology
- Marketing: Total cost of ownership vs. time to market
- CxO: Long term productivity and efficiency

Measurement – Benefits of Architecture Activities -1

Finally, the group turned its attention to how to measure the benefits imbued by specific architecture-related activities.

For an ATAM-based architecture evaluation, we realized that there are two kinds of risks uncovered: risks that were previously known, and risks that were previously unknown. However, even if a risk is known, it is not necessarily the case that it would have been acted on. One benefit of an ATAM evaluation exercise is that it elevates risks (even if previously known to the technical staff) to the attention of management, who can then allocated resources and room in the schedule to address them.

Measurement – Benefits of Architecture Activities -2

We reasoned that the expected benefit of an ATAM exercise can be expressed as follows:

SUM[i=1,n] [(cost of risk-I) x (probability of risk-I)] –
(cost of performing the evaluation)

where the risks are those uncovered by the evaluation that would not have been acted on without the exercise. This is a minimum benefit, because it does not take into account the intangible benefits such as increased stakeholder communication and improved documentation.

Measurement – Benefits of Architecture Activities -3

We then turned our attention to the benefit of architecture documentation. After brainstorming a list of reasons why documentation should be beneficial, the group crafted the following expression to quantify this benefit[1]:

Σ [i=1, n] { delta (cost of some activity) I } - (cost of documentation)

Activities include things like coding, analysis, project management planning, maintenance, making changes, performing downstream design, testing, and the like. The delta refers to the cost of performing that activity without documentation minus the cost of performing that same activity with documentation. Presumably the cost of carrying out these activities with documentation will be lower. (For activities that are not affected by having documentation, the delta is zero, and so these do not contribute to the benefit equation.)

The group suspected that this expression was, in fact, easily generalized to quantify the benefit of any architecture-related activity. We hypothesize that the benefit of such an activity is whatever cost reduction in subsequent activities as a result, minus the cost of the activity in the first place.

[1] The group originally added a term to this expression to count the "avoided cost of poor quality" to the benefit of documentation. However, subsequent consideration suggested that this avoided cost is captured in the reduced cost of subsequent activities.

Architecture and Process

This working session was chartered to discuss the relationship between architecture and process in the context of how to build systems and how the organization as a whole meets quality attribute requirements.

Some initial questions were raised to establish the groundwork for the discussion:

- What processes are relevant?
- Is there a reference framework that people use?
- On which processes does organizational context exist?
- How do we cope with processes that don't have an architecture focus?
- Are quality requirements solved in the architecture or within the organization or both? How are these aligned?

Architecture and Process – Common Models

- Few organizations use a predefined framework – they are building their own
- For the sake of argument, couldn't something like the Zachman framework be used as the common language or model for architecture and process. It has the most complete list of "stuff" and could be used to set the roadmap for an organization.
- There are many forces that impact the architecture, some are not quantifiable, e.g., none of the frameworks have a cell that includes politics and money.

Architecture and Process – Process Models -1

- Cultural differences between architecture and process is one of the biggest problems – often there is a lack of communication between the various groups
- There is no link between CMMI and architecture – the people involved are in different parts of the organization
- Bosch experience had separate rollout of product line and process improvement – although there was some cross-fertilization between the two groups by including architecture staff in the process group and vice versa.
- Software, system, and enterprise are inter-related and will be part of any discussion on the relationship of architecture and process.

Architecture and Process - Process Models -2

- Participants would like to see the SEI take the initiative and merge process and architecture – industry would be willing to pick it up from there
- Someone suggested starting with tailoring a light-weight ATAM in a SME (small to medium enterprise) process.
- CMMI is more descriptive (what to do) – architecture is more prescriptive (how to do it)
- IEEE Std 1471-2000 (IEEE Recommended Practice for Architectural Description of Software-Intensive Systems) tries to do this but is not being used
- Quality attributes are identified by the architecture and need to be incorporated within CMMI – CMMI does not give you any help to go from Business goals to processes – in the architecture there is a process for doing this

Architecture and Process – Architect's Role and Authority

- DoD has policy of procedure. Desire to elevate systems engineering (includes software architecture review) to same importance as cost and schedule. Provides method for system/software architect to have more influence on process
- Even when policies are in place, projects are schedule driven.
- Tension between person driving schedule and architect
- Architecture is part of quality and should be part of process. Currently there is a disconnect

Architecture and Process – Adoption

- Need simple assurance scheme
  - Stakeholder buy in
  - Technical feasibility
  - Test cases along the lines of the design
- Analogy to exercise, desire for silver bullet, people in denial, education process
- Perception – architecture take more time to do good system engineering. Yes it does – but rework is costlier.
- Move from awareness to commitment to architecture improvement (documentation, etc.)
- Need a champion within the organization – with some clout

Architecture and Process – Standards

- Industry depends on research organizations. Need clear focus on what need to be done. Making methods a "standard". Disconnect between architect, SEPG, project management. Opportunity for research organizations to take a leadership role to establish standard.
- Government model – "standard" could be stating what needs to be done without necessarily saying how. Different domains have different drivers. Dependent on buyer –smartness on what is needed in terms of life cycle view

Architecture and Process – ROI

- Source selection often does not reward innovation but takes conventional approach (appears less riskier). Significant ROI is needed to overcome risk
- What is the threshold for ROI for which an organization will accept a project?
- Short-term vs. long term focus